

# Campfire queen Cycling champion Sentimental geologist\*

Learn more about  
Marjon Walrod  
and tell us more  
about you. Visit  
[pwc.com/bringit](http://pwc.com/bringit).

Your life. You can  
bring it with you.



\*connectedthinking

PRICEWATERHOUSECOOPERS 

© 2006 PricewaterhouseCoopers LLP. All rights reserved. "PricewaterhouseCoopers" refers to PricewaterhouseCoopers LLP (a Delaware limited liability partnership) or, as the context requires, the PricewaterhouseCoopers global network or other member firms of the network, each of which is a separate and independent legal entity. \*connectedthinking is a trademark of PricewaterhouseCoopers LLP (US). We are proud to be an Affirmative Action and Equal Opportunity Employer.

THIRD EDITION

INTERMEDIATE  
**ALGEBRA**  
WITH APPLICATIONS

Terry H. Wesner  
*Henry Ford Community College*

Harry L. Nustad



**BERNARD J. KLEIN**  
**PUBLISHING**

**Book Team**

Editor *Terry Wesner*

Developmental Editor *Terry Baker*

Production Editor *Mary Klein*

# Bernard J. Klein Publishing

President *Joanne Klein*

Chief Executive Officer *Mary Ann Klein-Wesner*

Vice President, Publisher *Timothy J. Wesner*

Vice President, Director of Sales and Marketing *Robert S. Wesner*

Vice President, Director of Production *Thomas S. Wesner*

Cover credit: Terry Wesner

Production, illustrations, photo research, and composition by  
Publication Services, Inc.

The credits section for this book is considered an extension of the  
copyright page

Copyright © 2006 by Bernard J. Klein Publishing All rights reserved

GetMath Educational Software <http://www.getmath.com>

ISBN 1-932661-90-5

No part of this publication may be reproduced, stored in a retrieval system, or  
transmitted, in any form or by any means, electronic, mechanical,  
photocopying, recording, or otherwise, without the prior written permission of  
the publisher.

Printed in the United States of America by Bernard J. Klein Publishing

10 9 8 7 6 5 4





# Extra Credit Rocks

Sign up for a Discover® Student Card today and enjoy:

- 0% Intro APR\* on Purchases for 6 Months
- No Annual Fee
- Easiest Online Account Management Options
- Full 5% *Cashback Bonus*®\* on Get More purchases in popular categories all year
- Up to 1% *Cashback Bonus*®\* on all your other purchases
- Unlimited cash rewards that never expire as long as you use your Card

**APPLY NOW**

**DISCOVER**  
CARD

\*View Discover® Card Rates, Fees, Rewards and Other Important Information.

# Contents

20 point learning system	xiii
Preface	xix
Study tips	xxv

## Chapter 1 ■ Basic Concepts and Properties



1-1	Sets and real numbers	1
1-2	Operations with real numbers	12
1-3	Properties of real numbers	20
1-4	Order of operations	27
1-5	Terminology and evaluation	32
1-6	Sums and differences of polynomials	40
	Chapter 1 lead-in problem	46
	Chapter 1 summary	46
	Chapter 1 error analysis	47
	Chapter 1 critical thinking	47
	Chapter 1 review	47
	Chapter 1 test	49

## Chapter 2 ■ First-Degree Equations and Inequalities



2-1	Solving equations	50
2-2	Formulas and literal equations	59
2-3	Word problems	63
2-4	Equations involving absolute value	72
2-5	Linear inequalities	77
2-6	Inequalities involving absolute value	86
	Chapter 2 lead-in problem	93
	Chapter 2 summary	93
	Chapter 2 error analysis	94
	Chapter 2 critical thinking	95
	Chapter 2 review	95
	Chapter 2 cumulative test	96

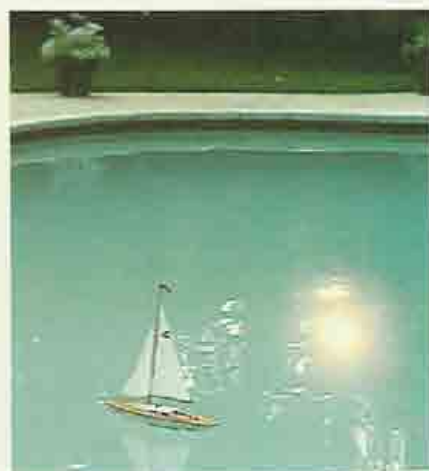


## Chapter 3 ■ Exponents and Polynomials



3-1	Properties of exponents	97
3-2	Products of polynomials	103
3-3	Further properties of exponents	111
3-4	Common factors and factoring by grouping	121
3-5	Factoring trinomials of the form $x^2 + bx + c$ and perfect square trinomials	126
3-6	Factoring trinomials of the form $ax^2 + bx + c$	133
3-7	Other methods of factoring	141
3-8	Factoring: A general strategy	147
	Chapter 3 lead-in problem	150
	Chapter 3 summary	151
	Chapter 3 error analysis	151
	Chapter 3 critical thinking	152
	Chapter 3 review	152
	Chapter 3 cumulative test	153

## Chapter 4 ■ Rational Expressions



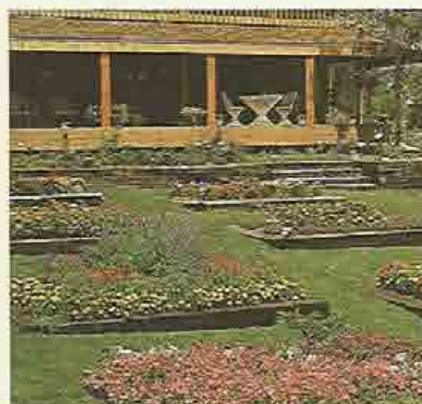
4-1	Fundamental principle of rational expressions	154
4-2	Multiplication and division of rational expressions	160
4-3	Addition and subtraction of rational expressions	166
4-4	Complex rational expressions	176
4-5	Quotients of polynomials	183
4-6	Synthetic division, the remainder theorem, and the factor theorem	188
4-7	Equations containing rational expressions	198
4-8	Problem solving with rational equations	203
	Chapter 4 lead-in problem	209
	Chapter 4 summary	210
	Chapter 4 error analysis	211
	Chapter 4 critical thinking	211
	Chapter 4 review	212
	Chapter 4 cumulative test	214

## Chapter 5 ■ Exponents, Roots, and Radicals



5-1	Roots and rational exponents	215
5-2	Operations with rational exponents	223
5-3	Simplifying radicals—I	226
5-4	Simplifying radicals—II	232
5-5	Sums and differences of radicals	237
5-6	Further operations with radicals	242
5-7	Complex numbers	246
	Chapter 5 lead-in problem	254
	Chapter 5 summary	254
	Chapter 5 error analysis	254
	Chapter 5 critical thinking	255
	Chapter 5 review	255
	Chapter 5 cumulative test	256

## Chapter 6 ■ Quadratic Equations and Inequalities



6-1	Solution by factoring and extracting roots	258
6-2	Solution by completing the square	266
6-3	Solution by quadratic formula	271
6-4	Applications of quadratic equations	278
6-5	Equations involving radicals	285
6-6	Equations that are quadratic in form	289
6-7	Quadratic and rational inequalities	293
	Chapter 6 lead-in problem	300
	Chapter 6 summary	301
	Chapter 6 error analysis	301
	Chapter 6 critical thinking	302
	Chapter 6 review	302
	Chapter 6 cumulative test	304

## Chapter 7 ■ Linear Equations and Inequalities in Two Variables



7-1	The rectangular coordinate system	305
7-2	The distance formula and the slope of a line	313
7-3	Finding the equation of a line	327
7-4	Graphs of linear inequalities	337
	Chapter 7 lead-in problem	343
	Chapter 7 summary	343
	Chapter 7 error analysis	344
	Chapter 7 critical thinking	345
	Chapter 7 review	345
	Chapter 7 cumulative test	346

## Chapter 8 ■ Systems of Linear Equations



8-1	Systems of linear equations in two variables	348
8-2	Applied problems using systems of linear equations	358
8-3	Systems of linear equations in three variables	367
8-4	Determinants	375
8-5	Solutions of systems of linear equations by determinants	380
8-6	Solving systems of linear equations by the augmented matrix method	388
	Chapter 8 lead-in problem	394
	Chapter 8 summary	395
	Chapter 8 error analysis	395
	Chapter 8 critical thinking	396
	Chapter 8 review	397
	Chapter 8 cumulative test	399



## Chapter 9 ■ Conic Sections



9-1 The parabola	401
9-2 More about parabolas	411
9-3 The circle	414
9-4 The ellipse and the hyperbola	420
9-5 Systems of nonlinear equations	429
Chapter 9 lead-in problem	435
Chapter 9 summary	435
Chapter 9 error analysis	436
Chapter 9 critical thinking	436
Chapter 9 review	437
Chapter 9 cumulative test	438

## Chapter 10 ■ Functions



10-1 Relations and functions	440
10-2 Functional notation	449
10-3 Special functions and their graphs	455
10-4 Inverse functions	460
10-5 Variation	468
Chapter 10 lead-in problem	475
Chapter 10 summary	475
Chapter 10 error analysis	475
Chapter 10 critical thinking	476
Chapter 10 review	476
Chapter 10 cumulative test	477



**Chapter 11 ■ Exponential and Logarithmic Functions**

11-1	The exponential function	479
11-2	The logarithm	485
11-3	Properties of logarithms	490
11-4	The common logarithms	496
11-5	Logarithms to the base $e$	500
11-6	Exponential equations	505
	Chapter 11 lead-in problem	507
	Chapter 11 summary	507
	Chapter 11 error analysis	508
	Chapter 11 critical thinking	509
	Chapter 11 review	509
	Chapter 11 cumulative test	511

**Chapter 12 ■ Sequences and Series**

12-1	Sequences	513
12-2	Series	518
12-3	Arithmetic sequences	523
12-4	Geometric sequences and series	529
12-5	Infinite geometric series	536
12-6	The binomial expansion	541
	Chapter 12 lead-in problem	546
	Chapter 12 summary	546
	Chapter 12 error analysis	547
	Chapter 12 critical thinking	547
	Chapter 12 review	548
	Final examination	550

Appendix	Answers and solutions	553
Index		633



## Student Loans for up to **\$40,000** per year\*

Defer payments until after graduation.\*\*  
Fast preliminary approval, usually in minutes.

 **Apply Now!**  
Go to [gmacbankfunding.com](http://gmacbankfunding.com)

## Apply online in as little as 15 minutes

- Loans up to \$40,000 per academic year\*
- Good for tuition and other educational expenses: books, fees, a laptop, room and board, travel home, etc.
- Get a check in as few as 5 business days
- Start payments now or up to six months after graduation\*\*
- Reduce your interest rate by as much as 0.50% with automatic payments\*\*\*

All loans are subject to application and credit approval.

\* Undergraduate and graduate borrowers may borrow annually up to the lesser of the cost of attendance or \$30,000 (\$40,000 for certain schools where it has been determined that the annual cost of attendance exceeds \$30,000). Borrowers in the Continuing Education loan program may borrow annually up to \$30,000.

\*\* Undergraduate students may choose to defer repayment until six months after graduation or ceasing to be enrolled at least half time in school. Interest only and immediate repayment options also available.

\*\*\* A 0.25% interest rate reduction is available for borrowers who elect to have monthly principal and interest payments transferred electronically from a savings or checking account. The interest rate reduction will begin when automatic principal and interest payments start, and will remain in effect as long as automatic payments continue without interruption. This reduced interest rate will return to contract rate if automatic payments are cancelled, rejected or returned for any reason. Upon request, borrowers are also entitled to an additional 0.25% interest rate reduction if (1) the first 36 payments of principal and interest are paid on time, and (2) at any time prior to the 36th on time payment, the borrower who receives the monthly bill elects to have monthly principal and interest payments transferred electronically from a savings or checking account, and continues to make such automatic payments through the 36th payment. This reduced interest rate will not be returned to contract rate if, after receiving the benefit, the borrower discontinues automatic electronic payment. The lender and servicer reserve the right to modify or discontinue borrower benefit programs (other than the co-signer release benefit) at any time without notice.

GMAC Bank Member FDIC

# 20 Point Learning System

Our students will count on Terry Wesner and Harry Nustad's integrated learning system. It is the product of over 50 years of combined teaching experience and has been developed with the help of feedback from users—both professors and students—through various texts and editions by this author team. The authors have fine-tuned and enhanced their learning system for this third edition of *Intermediate Algebra with Applications*. A full-color design makes an already superb learning system even better. The pedagogical color scheme is used consistently throughout, providing a road map to guide students through the key points of each section. Much more than just adding visual appeal, the color in this text is an integral part of the learning system. Let's take a look at examples of the 20 points that make up the learning system.

1. Chapter Lead-in Problem and Solution
2. Explanations
3. Examples
4. Quick Checks
5. Procedure Boxes
6. Definitions
7. Concepts
8. Notes
9. Problem Solving
10. Mastery Points
11. Section Exercises
12. Quick-Reference Examples
13. Trial Problems
14. Core Exercise Problems
15. Section Review Exercises
16. Chapter Summary
17. Error Analysis
18. Critical Thinking
19. Chapter Review Exercises
20. Cumulative Test


5

**Exponents, Roots,  
and Radicals**

The formula for approximating the velocity  $V$  in miles per hour of a car based on the length of its skid marks  $S$  (in feet) on wet pavement is given by

$$V = 2\sqrt{S}$$

If the skid marks are 147 feet long, what was the velocity of the car?



**2-1 • Roots and rational exponents**

**The  $n$ th root**

In chapter 2, we were concerned with raising some real number to a power. For example,

If  $a = -4$ , then  $a^3 = (-4)^3 = (-4)(-4)(-4) = -64$  (read “ $-4$  raised to the third power equals  $-64$ ”).

If  $a = 2$ , then  $a^4 = (2)^4 = (2)(2)(2)(2) = 16$  (read “ $2$  raised to the fourth power equals  $16$ ”).

In this chapter, we will reverse that process. That is, we will start with a power of a real number  $a$  and find  $a$ .

**Definition of  $n$ th root**

For every pair of real numbers  $a$  and  $b$  and every positive integer  $n$  greater than 1, if

$$b^n = a$$

then  $b$  is called an  $n$ th root of  $a$ .

**Concept**

An  $n$ th root of a number is one of  $n$  equal factors that, when multiplied, equal the number.

• 215

A **chapter-opening application** problem with full-color photo poses a problem that students will learn to solve as they progress through the chapter. Its step-by-step solution is shown before the chapter summary.



**Procedure boxes** clearly state step-by-step processes for working problems.

**Examples** include arrows that visually guide students through steps needed to solve the problem. A detailed explanation to the right of each step ensures student understanding of the correct solution method.

## 3

Exponents and Polynomials

Exponents and Polynomials

The amount,  $A$ , of a radioactive substance remaining after time  $t$  can be found using the formula  $A = A_0(5)^{-t/5770}$ , where  $A_0$  represents the original amount of radioactive material and  $t$  is the half-life given in the same units of time as  $t$ . If the half-life of radioactive carbon-14 is 5,770 years, how much radioactive carbon-14 will remain after 11,540 years if we start with 100 grams?

**3-1 Properties of exponents**

**Exponential form**

In chapter 1, we discussed exponents as related to real numbers. Since variables are symbols for real numbers, we shall now apply the properties of exponents to them. The expression  $a^n$  (read “ $a$  to the third power”) is called the **exponential form of the product**.

$a \cdot a \cdot a$

We call  $a$  the **base** and  $n$  the **exponent**.

$a \cdot a \cdot a$   
product

$\xrightarrow{\text{Exponential form}}$

$a^3$   
exponent

$a^3 = a \cdot a \cdot a = 3 \cdot a$

**Definition of exponents**

$a^n = \underbrace{a \cdot a \cdot a \cdot \dots \cdot a}_n$

where  $n$  is a positive integer.

**Concept**

The exponent tells us how many times the base is used as a factor in an indicated product.

Section 1-6: Sums and Differences of Polynomials 41

Using the distributive property, the expression can be written

$$-3x + 5x = (-1 + 1)x = 4x$$

In this expression,  $4x$  and  $5x$  are terms that we wish to add. Terms are separated by the operations of addition and subtraction.

Simplifying expressions, as in this example, is combining **like terms**. **Like terms** are terms that may differ only in their numerical coefficients. For two or more terms to be called like terms, the variable factors of the terms along with their respective exponents must be identical. However the numerical coefficients may be different.

- $3x^2y^3$ ,  $-3x^2y^3$ , and  $3xy^3$  are like terms because they differ only in their numerical coefficients.
- $5x^2y^3$  and  $5x^2y^3$  both contain the same variables but are not like terms because the exponents of the respective variables are not the same.

**Combining like terms**

- Identify the like terms.
- If necessary, use the commutative and associative properties to group together the like terms.
- Combine the numerical coefficients of the like terms and multiply them by the variable factors.
- Remember that  $y$  is the same as  $1 \cdot y$  and  $-y$  is the same as  $-1 \cdot y$ .

**Note:** The process of addition or subtraction is performed only with the numerical coefficients; the variable factors remain unchanged.

**Perform the indicated addition or subtraction**

- $$3x - 7x + 2 = -4x + 2$$

$$= (-4 + 1)x + 2 = -3x + 2$$
- $$2x^2y + 5x^2y + 2x^2y = (2 + 5 + 2)x^2y = 9x^2y$$
- $$3x^2y + 8x^2y - 3x^2y + 2x^2y$$

$$= (3 + 8 - 3 + 2)x^2y = 10x^2y$$

**Note:** The numerical coefficient of a term includes the sign that precedes it. Therefore we consider any addition and subtraction of terms as a sum of terms in which the sign that precedes the term is taken as the sign of the numerical coefficient.

**Quick check:** Perform the indicated addition or subtraction.

$$5x^2y - 3x^2y + 7x^2y$$

**Quick checks** parallel the development of examples within the text and allow students to immediately test their understanding of the material being studied. The quick check problem is worked step-by-step within the exercise set. The student is able to line-by-line check his or her own solution and use this solution as a quick reference while doing the problems within the exercise set. Notice that these quick check problems become the quick-reference examples on page 44.

**Definitions** are stated precisely in easy-to-understand terms.

**Example 2-1 A**

**Note:** An exponent acts only on the symbol immediately to its left, that is, in  $x^2$ , the exponent 2 applies only to the base  $x$ ; whereas  $(xy)^2$  would mean the exponent applies to both the  $x$  and the  $y$ .

Write each expression in exponential form and identify the base and the exponent.

1.  $x \cdot x \cdot x \cdot x = x^4$  Base:  $x$ ; exponent: 4
2.  $4 \cdot 4 \cdot 4 = 4^3$  Base: 4; exponent: 3
3.  $(x^2)^3 = (x)(x) \cdot (x)(x) \cdot (x)(x) = (x^2)^3 = (x^2)^3$  Base:  $x^2$ ; exponent: 3
4.  $(-3)(-3)(-3)(-3)(-3) = (-3)^5$  Base: -3; exponent: 5
5.  $-2 \cdot 2 \cdot 2 \cdot 2 = -2^4$  Base: 2; exponent: 4

**Note:** In examples 4 and 5, we review the ideas of exponents related to signed numbers. See 3) that  $(-3)^4 = 81$ , whereas  $-3^4 = -81$ .

**Quick check:** Write  $(-3)(-3)(-3)(-3)$  in exponential form and identify the base and the exponent.

**Product property of exponents**

Consider the indicated product of  $a^2 \cdot a^3$ . If we rewrite  $a^2$  and  $a^3$  by using the definition of exponents, we have

$$a^2 \cdot a^3 = \underbrace{a \cdot a}_{\text{2 factors of } a} \cdot \underbrace{a \cdot a \cdot a}_{\text{3 factors of } a}$$

And again using the definition of exponents, this becomes

$$a^2 \cdot a^3 = \underbrace{a \cdot a \cdot a \cdot a \cdot a}_{\text{5 factors of } a} = a^5$$

This leads us to the observation that

$$\begin{array}{c} \text{2 factors of } a \\ a^2 \cdot a^3 = a^5 \\ \text{3 factors of } a \end{array}$$

**Product property of exponents**

For all real numbers  $a$  and positive integers  $m$  and  $n$ ,

$$a^m \cdot a^n = a^{m+n}$$

**Concept**

When multiplying factors having like bases, add the exponents to get the exponent of the common base.

**Concept boxes** contain the authors' easy-to-understand explanations of properties. Here the authors translate algebraic statements into everyday language.

**Problem solving** motivates students by relating mathematics to the everyday world.

**Mastery points** are listed before each section's exercise set to alert students to the skills they must have mastered to successfully work the problems.

**Notes** to the student highlight important ideas and point out potential student errors.

**Explanations** are written as if the authors are talking directly to students.

## Section 1-5 Terminology and Evaluation 37

## 1-5 A

Write an algebraic expression for each of the following.

1. The product of  $x$  and  $y$   $x \cdot y$
2. The sum of 4 and 7  $4 + 7$
3.  $y$  decreased by 3  $y - 3$
4.  $x$  divided by 4  $x \div 4$  or  $\frac{x}{4}$
5. A number divided by 6. Let  $n$  represent the number  $n \div 6$
6. Three times a number and that number increased by 9. Let  $n$  represent the number  $3n + 9$
7. A number divided by 4 and that quotient decreased by 2. Let  $n$  represent the number  $\frac{n}{4} - 2$
8. Five times the sum of a number and 6. Let  $n$  represent the number  $5(n + 6)$

**Quick check** Write an algebraic expression for each of the following:

1. the product of  $x$  and  $y$
2. a number increased by 2

**Mastery points****Can you**

- Identify terms in an expression?
- Identify a polynomial by name?
- Determine the degree of a polynomial?
- Evaluate an algebraic expression?
- Evaluate a polynomial using polynomial  $P(x)$  notation?
- Write an algebraic expression?

**Exercise 1-5**

Specify the number of terms in each expression and determine if the expression is a polynomial. See examples 1-5 A and C.

**Example:**  $x^2 + 2x^4$   
**Classification:** 2 terms; polynomial (quadratic)

**Exercise sets** feature both algebraic and word problems that give students ample opportunity to practice their skills.

Fully worked-out **quick-reference examples** (quick check problems) are included for students to use as a line-by-line check of their work or as an example.

**Core exercise problems** address the major ideas of the section. The problem numbers for these exercises appear in green type for easy identification.

**Trial exercise problems** are located in the exercise sets and are denoted with a box around the problem number indicating that the solution is completely worked out in the answer appendix. The problem can be used as an example or line-by-line check of the problem.

## Mastery points

## Can you

- Identify like terms?
- Perform addition and subtraction of polynomials?
- Remove grouping symbols?

## Exercise 1-5

Perform the indicated addition or subtraction. See example 1-6 A.

**Example**  $3xy^3 - (xy^3 + 2xy^3)$

**Solution**  $(3 - 1 - 2)xy^3$

*Subtract like terms.*

*Combine like terms.*

*Remove grouping symbols.*

$$1. 4x + 6y^2 - 2x^2 + 3x - 5x^2 + x$$

$$2. 5y^2 - 12y + 8y^2 - 6y^2 + y$$

$$3. -x^2 + x - 5x^2 + 5x^2 + 4x$$

$$4. 2xy - 4xy^2 + 3xy^2$$

$$5. 5x^2y - 3xy + 6xy - x^2y$$

$$6. 8x^2y - 2ab^2 + 12x^2y - 4x^2y$$

$$7. 3x^2 + 2x - 4 - (x^2 - 7x + 9)$$

$$8. 5x^2 + 4y - (4x^2 + 3y) - (x^2 - 3y)$$

$$9. (3x^2 - 2xy + 9xy) + (2xy^2 - 4xy^2 + 3xy)$$

$$10. (7x^2 - 2xy + 4xy^2 - 6y^2) - (x^2 - 3xy - 2xy^2 - y^2)$$

$$11. (12x - 24y) + (40xy - 16x - 20y)$$

$$12. (19x + 3y) - (-22x + 8y)$$

$$13. -15ab - 5ab + 16c = (7ab - 4c^2)$$

$$14. (8ab + 11c^2) - (11ab - 6c)$$

$$15. -(14x - 31y) - (14x - 6y + 3z)$$

$$16. (x^2 - 3x + 2) - (x^2 + 5x - 8) + (3x^2 - 4x)$$

$$17. (2x^2 - 7x + 3) + (5x^2 - 6) - (4 - 3x^2)$$

$$18. (2x^2 - 3xy + y^2) + (3x^2 - 8y^2 + 3xy) - (4x^2 - 6x^2 - xy)$$

$$19. (5xy - y^2) - (3xy + 2xy) + (11x^2 - 4xy)$$

$$20. (8ab - 2ab^2 + 3a) - (4a^2b - 3ab^2) + (2ab - 7a)$$

$$21. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$22. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$23. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$24. (4x^2 + 3x - 2y^2) - (-4x^2y^2 + 3ab - 7)$$

$$25. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$26. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$27. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$28. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$29. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$30. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$31. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$32. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$33. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$34. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$35. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$36. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$37. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$38. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$39. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$40. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$41. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$42. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$43. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$44. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$45. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$46. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$47. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$48. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$49. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$50. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$51. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$52. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$53. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$54. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$55. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$56. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$57. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$58. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$59. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$60. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$61. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$62. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$63. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$64. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$65. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$66. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$67. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$68. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$69. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$70. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

$$71. (-11x^2y^2 + 5xy - 8) - (-11x^2y^2 + 5xy - 8)$$

$$72. (3x^2 + 4xy - \frac{1}{2}y^2) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$73. (4x^2 + 5ab + 14c) + (\frac{1}{2}y^2 - 5ab - \frac{1}{2}y^2)$$

$$74. (3x^2y - 2x^2y^2 + 3xy^2) + (2x^2y^2 - 3x - 4xy^2)$$

$$75. (-3x^2y^2 + 3ab - 7) - (-11x^2y^2 + 5xy - 8)$$

**Review exercises** at the end of each section help students prepare for the following section and keep in touch with previous material.



## Chapter 5 lead-in problem

The formula for approximating the velocity  $v$  in miles per hour of a car based on the length of its skid marks  $s$  (in feet) on wet pavement is given by

$$v = 2\sqrt{35s}$$

If the skid marks are 147 feet long, what was the velocity of the car?

## Solution

$$\begin{aligned} v &= 2\sqrt{35s} \\ v &= 2\sqrt{35 \cdot 147} \\ v &= 2\sqrt{5145} \\ v &= 2\sqrt{441 \cdot 11} \\ v &= 2 \cdot 21\sqrt{11} \\ v &= 42\sqrt{11} \end{aligned}$$

Hence, the velocity of the car was  $42\sqrt{11}$  miles per hour.

The completely worked-out solution for the **chapter-opening word problem** appears at the end of the chapter prior to the chapter summary.

## Chapter 5 summary

1.  $a^m \cdot a^n = a^{m+n}$ , whenever the principal  $n^{\text{th}}$  root of  $a$  is a real number.
2.  $a^m \cdot a^n = (a^m)^n = a^{mn}$ , if the principal  $n^{\text{th}}$  root of  $a$  is a real number.
3. For all nonnegative real numbers  $a$  and  $b$  and positive integer  $n$ ,  $a^n \cdot b^n = (a \cdot b)^n$ .

$$\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{a \cdot b} \quad a \geq 0, b \geq 0$$

$$\sqrt[n]{a} = a^{1/n}$$

## Chapter 5 error analysis

1. Principal  $n^{\text{th}}$  root.  
Example:  $\sqrt[3]{81} = 9$  or  $-9$ .  
Correct answer: 9.  
What error was made? (see page 216)
2. Principal  $n^{\text{th}}$  root.  
Example:  $\sqrt[3]{-8}$  does not exist in the real numbers.  
Correct answer:  $-2$ .  
What error was made? (see page 216)
3. Rational number exponents.  
Example:  $(12)^{1/2} \cdot (12)^{1/3} = (12)^{5/6} = 12$ .  
Correct answer:  $\frac{1}{2}$ .  
What error was made? (see page 221)
4. Operations with rational exponents.  
Example:  $3^{1/2} \cdot 2^{1/2} = 2^{1/2}$ .  
Correct answer:  $6^{1/2}$ .  
What error was made? (see page 224)
5. Product of radicals.  
Example:  $\sqrt{3} \cdot \sqrt{2} = \sqrt{6}$ .  
Correct answer:  $\sqrt{6}$ .  
What error was made? (see page 228)

6. We eliminate radicals from the denominator of a fraction by rationalizing the denominator.
7. We can only add or subtract like radicals.
8. Conjugate factors are used to rationalize the denominator of a fraction when the denominator has two terms where one or both terms contain a square root.
9. We define  $i = \sqrt{-1}$ , so that  $i^2 = -1$ .
10. A complex number is any number that can be written in the form  $a + bi$ , where  $a$  and  $b$  are real numbers and  $i$  represents  $\sqrt{-1}$ .
11. Reducing the index.  
Example:  $\sqrt[4]{81} = \sqrt[4]{3^4} = 3$ .  
Correct answer:  $\sqrt[4]{81}$ .  
What error was made? (see page 229)
12. Rationalizing the denominator.  
Example:  $\frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{\sqrt{2}}$ .  
Correct answer:  $\frac{\sqrt{2}}{2}$ .  
What error was made? (see page 234)
13. Sum of radicals.  
Example:  $\sqrt{2} + \sqrt{2} = \sqrt{4}$ .  
Correct answer:  $2\sqrt{2}$ .  
What error was made? (see page 238)
14. Radical of a sum.  
Example:  $\sqrt{16 + 9} = \sqrt{25} = 5$ .  
Correct answer:  $5$ .  
What error was made? (see page 238)
15. Multiplying radicals.  
Example:  $\sqrt{2} \cdot \sqrt{3} = \sqrt{6}$ .  
Correct answer:  $\sqrt{6}$ .  
What error was made? (see page 242)

A **chapter summary** synthesizes important concepts.

**Error analysis** provides a group of problems where a common error has been made. The student is asked to correct the mistake. A page reference is provided so that the student can refer to examples and notes relative to the given problem.

**Critical thinking** provides special problems that the student must analyze and use their mathematical skills to solve. A series of hints are given in the Instructors Manual.

**Chapter review exercises** feature problems to help students determine if they need further work on a particular section. The problems are keyed to refer students back to the section from which they were drawn.

## Chapter 5 critical thinking

Choose a two-digit number whose unit's digit is 5 (such as 35). You can find the square of this number if you multiply the ten's digit by one more than the ten's digit and place 25 after this product. For example:

$$\begin{array}{r} \text{Ten's} \quad \text{One more than the} \quad \text{Product} \quad \text{Place 25 after} \\ \text{digit} \quad \text{ten's digit} \quad \text{the product} \end{array}$$

$$3 \quad 4 \quad 12 \quad 25$$

$$35^2 = 1225$$

Therefore,  $35^2 = 1225$ .  
Why is this true?

## Chapter 5 review

Assume that all variables represent positive real numbers and no denominator is equal to zero.

[5-1]

Rewrite the following in simplest notation and use table 5-1 to simplify.

$$1. 36^{1/2} \quad 2. 16^{3/4} \quad 3. (-27)^{1/3}$$

[5-2]

Perform the indicated operations and simplify. Leave the answer with all exponents positive.

$$\begin{array}{lll} 4. x^{1/2} \cdot x^{1/4} & 5. (x^2 y)^{1/3} & 6. (27x^3)^{1/3} \\ 7. (x^2 y)^{1/3} & 8. (x^2 y)^{1/3} & 9. \frac{x^{1/2} y^{1/4}}{x^{1/4} y^{1/2}} \\ 10. \frac{x^{1/2} y^{1/4}}{x^{1/4} y^{1/2}} & 11. \frac{x^{1/2} y^{1/4}}{x^{1/4} y^{1/2}} & 12. \frac{x^{1/2} y^{1/4}}{x^{1/4} y^{1/2}} \end{array}$$

[5-3]

Simplify the following.

$$\begin{array}{lll} 13. \sqrt{75} & 14. \sqrt{18} \sqrt{12} & 15. \sqrt[3]{27} \sqrt[3]{8} \\ 16. \sqrt[3]{64} & 17. \sqrt[3]{64} & 18. \sqrt[3]{64} \end{array}$$

19. If the hypotenuse of a right triangle is 10 inches long and one of the legs is 6 inches long, find the length of the other leg.

[5-4]

Simplify the following expressions, leaving no radicals in the denominator.

$$\begin{array}{lll} 19. \sqrt{\frac{2}{3}} & 20. \sqrt{\frac{1}{2}} & 21. \sqrt{\frac{1}{3}} \\ 22. \sqrt{\frac{1}{4}} & 23. \sqrt{\frac{1}{5}} & 24. \sqrt{\frac{1}{6}} \\ 25. \sqrt{\frac{1}{7}} & 26. \sqrt{\frac{1}{8}} & 27. \sqrt{\frac{1}{9}} \\ 28. \sqrt{\frac{1}{10}} & 29. \sqrt{\frac{1}{11}} & 30. \sqrt{\frac{1}{12}} \end{array}$$

[5-5]

Perform the indicated operations and simplify.

$$\begin{array}{lll} 31. 4\sqrt{7} - 3\sqrt{2} + 7\sqrt{3} & 32. \sqrt{18} + \sqrt{32} & 33. \sqrt{8} + 3\sqrt{18} \\ 34. 7\sqrt{2} \sqrt{3} - 2\sqrt{2} \sqrt{3} & 35. \frac{1}{\sqrt{2}} - \frac{1}{\sqrt{3}} & 36. \frac{1}{\sqrt{2}} - \frac{1}{\sqrt{3}} \end{array}$$

# 258 Chapter 5 Exponents, Roots, and Radicals

[5-6]

Simplify the following expressions leaving no radicals in the denominator.

37.  $\sqrt{2}(\sqrt{5} - \sqrt{10})$

38.  $2\sqrt{6}(\sqrt{3} + 1/\sqrt{6})$

39.  $(5 - \sqrt{10})^2$

40.  $(\sqrt{10} - \sqrt{5})(\sqrt{10} + \sqrt{5})$

41.  $(2\sqrt{5} + 1/\sqrt{5})(2\sqrt{5} - 2/\sqrt{5})$

42.  $(2\sqrt{5} + \sqrt{5})^2$

43.  $\frac{1}{\sqrt{6} + 1}$

44.  $\frac{10}{4 + \sqrt{6}}$

45.  $\frac{\sqrt{3}}{\sqrt{6} - \sqrt{2}}$

46.  $\frac{2\sqrt{2}}{\sqrt{2}(\sqrt{2} - \sqrt{10})}$

[5-7]

Simplify the following.

47.  $\sqrt{-49}$

48.  $\sqrt{-25}$

49.  $(3i)^2$

50.  $(\sqrt{7}i)^2$

51.  $\sqrt{-3} \sqrt{-12}$

Simplify the following and leave the answer in standard form.

55.  $(4 + 5i) + (3 + 3i)$

56.  $(2 - \sqrt{-25}) + (3 + \sqrt{-25})$

57.  $(2 - \sqrt{-25})(3 + \sqrt{-18})$

58.  $12 + 5i^2$

59.  $\frac{3 + 4i}{i}$

60.  $\frac{7 - 6i}{\sqrt{-8}}$

61.  $\frac{6 - i}{2 + i}$

62.  $\frac{8 + \sqrt{-4}}{2 - \sqrt{-9}}$

## Chapter 5 cumulative test

Factor completely.

[2-3] 1.  $x^2 - 7x + 8$

[3-4] 2.  $3x^2 - 5x$

[3-7] 3.  $9x^2 - 16$

[3-6] 4.  $2x^2 + 11x + 12$

[3-6] 5.  $3x^2 - 11x - 20$

[3-6] 6.  $6x^2 + 17x + 12$

[1-5] 7. Evaluate the expression  $W = 4ac + b$ .

(a)  $a = 1$ ,  $b = 4$ , and  $c = -3$

(b)  $a = 1$ ,  $b = -4$ , and  $c = 3$

Find the missing side.

[2-1] 8.  $3(2a - 1) = c = a + 3$

[2-5] 9.  $3x + 7 = 2x - 4$

[2-2] 10.  $3x - 2y = 4(x + y)$

[2-4] 11.  $3x + 1 = 0$

[2-5] 12.  $2x + 3(2 - 5)$

[2-1] 13.  $3(x + 1) - (x - 3)^2 = 8$

[2-6] 14.  $1 - 4a \leq 5$

Simplify the following and leave in standard form. Assume that all variables represent positive real numbers.

[5-3] 15.  $\sqrt[3]{54x^{12}y^9}$

[5-7] 16.  $(3 - 4i)(2 + 5i)$

[5-3] 17.  $\sqrt[3]{125}$

[5-2] 18.  $2^{11} \cdot 4^{12}$

[5-2] 19.  $\sqrt[3]{64x^6y^3}$

[3-1] 20.  $(2a^3b^2)^3$

[5-7] 21.  $\sqrt[3]{125}$

[5-6] 22.  $\frac{4}{\sqrt[3]{16} + \sqrt[3]{8}}$

[5-7] 23.  $\frac{1 - 2i}{2 + 3i}$

[5-2] 24.  $(4a^2)^{1/3}$

[3-3] 25.  $\frac{31 - 5i^2}{3i - 1/2}$

[5-4] 26.  $\sqrt[3]{\frac{27}{64}}$

Chapter 5 Cumulative Test 257

Solve the following word problems.

[2-3] 27. When the length of a side of a square is increased by 4 inches, the area is increased by 72 square inches. Find the original length of a side.

[2-3] 28. A metallurgist wishes to form 1,000 kg of an alloy that is 62% copper. This alloy is to be obtained by fusing some alloy that is 88% copper and some that is 39% copper. How many kilograms of each alloy must be used?

[5-1] 29. In the theory of ballistics, the ballistic force  $x$  of a material is approximated by the formula

$$x = 42kT$$

where  $T$  is the thickness of a sheet of material and  $k$  is a constant that is dependent on the material being used. Compute the ballistic force of

(a)  $k = 24,000$  and  $T = 0.0125$ .

(b) Use the formula in exercise 29 to find  $x$  if

$$k = 25,000 \text{ and } T = 0.0175.$$

**Cumulative tests** emphasize the "building-block" nature of mathematics and help students retain knowledge and skills from previous chapters.

# Need more money for college expenses?

The CLC Private Loan<sup>SM</sup> can get you up to  
**\$40,000** a year for college-related expenses.

Here's why the CLC Private Loan<sup>SM</sup> is a smart choice:

- ✓ Approved borrowers are sent a check within four business days
- ✓ Get \$1000 - \$40,000 each year
- ✓ Interest rates as low as prime + 0% (8.66% APR)
- ✓ Quick and easy approval process
- ✓ No payments until after graduating or leaving school

**CLICK HERE**

or call **800.311.9615.**

*We are available 24 hours  
a day, 7 days a week.*



# Preface

*Intermediate Algebra with Applications* is designed to be used as an intermediate level text for students who have had some prior exposure to beginning algebra in either high school or college. In this third edition, we have maintained our philosophy of explaining the why's of algebra, rather than simply expecting students to imitate examples. Sections are presented in such a way that, as topics progress, students realize they are actually extending properties they have already learned.

**Problem-solving orientation** The emphasis on problem solving begins in chapter 1 with word problems that have simple arithmetic solutions. The student also learns to change word phrases into algebraic expressions. In chapter 2 and throughout the rest of the text, the student is shown how to form and solve equations from word problems.

**Diagrams** are used to show how the words are translated into mathematical symbols. **Tables** are provided to illustrate how several different word phrases become the same mathematical expression.

**Critical thinking** To encourage students to approach problems creatively in mathematics and the real world, we have included a critical thinking exercise in each chapter.

**Error analysis** Students can effectively increase their level of understanding of mathematical concepts by evaluating problems illustrating some of the most common mathematical errors. This strengthens the students' understanding of the concept and provides extra practice restating the concept in their own words.

**Readability** We have attempted to make the text as readable and accessible to students as possible by presenting the material in a manner similar to that which the instructor might use in the classroom.

**Applications** We have tried to provide a cross section of applications, mainly in the exercises. These are provided to help answer the perennial question "Why am I studying this stuff?" and to make the learning process itself more interesting. In particular, we have tried to show that algebra has become more important than ever in this age of the digital computer. Most ideas are supported by real-life applications relative to that concept.

**Functional use of color** In this third edition, color has been used to guide students through the text and clearly show the hierarchy of the text's elements. The effective use of color for each particular text element groups similar kinds of elements and helps students understand the relative importance of the elements.

- **Green** is reserved for the core ideas and core exercise problems presented in each chapter; it is used to highlight procedures, properties, definitions, notes, mastery points, and core exercise problems.
- **Blue** is used to emphasize explanations within the examples and exposition.
- **Red** is used to highlight extra practice opportunities for students within the development of each topic.

## Highlights of the learning aids

**Examples** Examples present all aspects of the material being studied with a step-by-step development showing how the problem is worked. Examples have short phrase statements in **blue** type next to most steps stating exactly what has been done. The student is able to develop a clear understanding of how a problem is worked without having to guess what went on in a particular step.

**Quick check exercises** These exercises after a set of examples are designed to involve the student with the material while studying it. Quick check exercises directly parallel the development and examples in the text. As each new idea or procedure is illustrated with a set of examples, the student is asked to work a similar problem. A **red** triangle identifies each quick check exercise. Quick check exercises are worked step-by-step as quick-reference examples within the exercise set.

**Procedure boxes** Procedure boxes clearly state a step-by-step summary of the process by which types of problems are to be worked. **Green** has been consistently used for all procedure boxes to emphasize their importance to students.

**Concept boxes** Concept boxes include properties, theorems, or definitions along with an explanation in easy-



to-understand language. **Green** is used to outline each concept box, emphasizing its importance.

**Notes** Notes to the student highlight important ideas and point out potential errors that students might make. The notes are printed in **green** type to attract the student's attention and to emphasize their importance.

**Mastery points** Mastery points are listed before each exercise set. In essence, they are objectives for that section. They are specifically placed in this location to alert students to the particular skills they must know to successfully work the problems. We have found the objectives have more meaning for students after they have completed the section. The **green** outlined box is used to draw the students' attention to the mastery points before they begin the exercise set and to mark the mastery points as covering part of the main ideas of the section.

**Exercise sets** Exercise sets provide abundant opportunities for students to check their understanding of the concepts being presented. The problems in the exercise sets are carefully paired and graded by level of difficulty to guide the students easily from straightforward computations to more challenging, multi-step problems.

**Green** type problem numbers identify the core exercise problems in each exercise set.

The directions for each group of problems refer the student to a specific group of parallel examples. After each set of directions is a **quick-reference example**. This example is a specifically chosen quick check exercise from the section and is worked and explained step-by-step. The **red** shading over each quick-reference example tells students it is related to the quick check exercises. Students can use this as a line-by-line check of their solution if they worked the problem while studying the material, or as an example they can refer to while working the exercise set.

**Review exercises** At the end of each section is a group of review problems. These exercises help reinforce the skills necessary for success in the following section. Answers are provided for all the review exercises.

**Trial exercise problems** Trial exercise problems appear throughout each exercise set and are denoted by a box around the problem number. This indicates that the solution

is shown in its entirety in the answer appendix.

**Chapter summaries** End-of-chapter summaries synthesize the important ideas of each chapter.

**Error analysis** At the end of each chapter is a group of problems in which a typical error has been made. The student is asked to find and correct the mistake. If the student cannot find the error, a page reference is given which directs the student back to a specific note or group of examples that focus on this problem. Error analysis helps students increase their ability to find errors when checking their solutions and encourages them to practice restating the important ideas of the chapter in their own words.

**Critical thinking** Following error analysis is a special problem that requires the student to analyze a problem and use their mathematical skills to answer it. The *Instructor's Resource Manual* contains a series of hints that can be used to guide the student through the analysis of the problem. The *Instructor's Resource Manual* also discusses various ways that critical thinking can be integrated into your course.

**Chapter review** A chapter review is placed at the end of each chapter. This problem set follows the same organization as the chapter. Each problem is keyed to the section from which it was drawn. Answers to all review problems are provided in the appendix.

**Cumulative tests** Cumulative tests give students the opportunity to work problems that are drawn from the chapter and from preceding chapters. If students need to review, they can use the section references to review the concept.

**Answers** Answers are given for all odd-numbered section exercise problems. The answers to all problems in the chapter reviews and cumulative tests are provided in the appendix.

## New to this edition

### Content

1. Sums and differences of polynomials has been moved from chapter 3 in the second edition to chapter 1 in the third edition. This allows the student to concentrate on adding and subtracting like terms before introducing properties of exponents in chapter 3.



2. Solving absolute value equations and inequalities has been separated in this third edition. Solving absolute value equations is placed after solving word problems and solving absolute value inequalities comes after solving linear inequalities. This separation of absolute value equations from the absolute value inequalities limits possibilities for confusion among students. The separate coverage of absolute value inequalities also reinforces many of the skills developed with absolute value equations.
3. Factoring in chapter 3 has been streamlined. It now includes a greater use of diagrams to illustrate the concepts.
4. Synthetic division moves from the appendix to section 4–6. The remainder theorem and the factor theorem are developed in conjunction with the work with synthetic division.
5. A separate section dealing with operations with rational exponents has been added to chapter 5. This follows a graded approach that is more accessible to students.
6. Section 8–2 is now a section on applications of systems of linear equations in two variables. In this edition, it is developed in a separate section allowing greater explanation and expansion of the amount of practice students encounter in exercises.  
Section 8–4 is now a separate section on the Definition and Evaluation of Determinates of 2nd, 3rd, and 4th order. Formerly part of old section 8–3. This separate treatment allows for greater development of these topics.
7. A new section has been added to chapter 9. In section 9–2, “More about Parabolas,” students learn to solve and graph parabolas whose equations are of the form  $x = ay^2 + by + c$  ( $a \neq 0$ ).
3. Quick-reference problems are worked out in the exercise sets to serve as further examples for the student.
4. Greater use of arrows to point up important steps taken in the development of an example.
5. Examples have step-by-step development showing how the problem is worked with short phrase statements next to most steps stating exactly what has been done.
6. All step-by-step procedures outlined for the major concepts are placed in boxes for emphasis.
7. Core exercise problems have been identified with green problem numbers in the exercise sets to highlight the appropriate problems for a basic assignment.
8. Review exercises at the end of each section have been added to help prepare the student for the work of the following section.
9. Error Analysis in each chapter helps students find errors and apply concepts in their own terms.
10. Critical Thinking activities in each chapter help students learn to address multi-step complex problems.
11. Color is used to clearly show which elements are related and to highlight the important concepts for the students.

## Features

1. Each chapter is introduced with an application problem (an accompanying related photo) that can be solved using the procedures studied in the ensuing chapter. The application problem is worked out in detail at the end of the chapter, just prior to the chapter summary for that chapter.
2. Quick check problems have been added within the textual material to give students immediate practice with each new concept.

## For the instructor

The *Instructor's Resource Manual* has been expanded to include all critical thinking exercises from the text (with hints and solutions), a guide to the supplements that accompany *Intermediate Algebra with Applications*, Third Edition, and reproducible quizzes, multiple chapter tests, and extension problems. Also included are a complete listing of all mastery points and suggested course schedules based on the mastery points. The final section of the *Instructor's Resource Manual* contains answers to the reproducible materials.

The *Instructor's Solutions Manual* contains completely worked-out solutions to all of the exercises in the textbook.

The *Educator's Notebook* is designed to assist you in formatting and presenting the concepts of *Intermediate Algebra with Applications*, Third Edition to your students. Reproducible transparency masters are provided for each section of the textbook.



The **Test Item File/Quiz Item File** is a printed version of the computerized *TestPak* and *QuizPak* that allows you to choose test items based on chapter, section, or objective. The objectives are taken directly from the mastery points in *Intermediate Algebra with Applications*, Third Edition. The items in the *Test Item File* and *Quiz Item File* are different from those in the prepared tests in the *Instructor's Manual*. Hence, you will have even more items to choose from for your tests.

**WCB TestPak 3.0**, our computerized testing service, provides you with a call-in/mail-in testing program and the complete *Test Item File* on diskette for use with IBM® PC, Apple®, or Macintosh® computers. **WCB TestPak** requires no programming experience. Tests can be generated randomly, by selecting specific test items or mastery points/objectives. In addition, new test items can be added and existing test items can be edited.

**WCB GradePak**, also a part of *TestPak 3.0*, is a computerized grade management system for instructors. This program allows you to track students' performance on examinations and assignments. It will compute each student's percentage and corresponding letter grade, as well as the class average. Printouts can be made utilizing both text and graphics.

**WCB TestPak 3.0** disks and the WCB call-in service are available free to instructors adopting *Intermediate Algebra with Applications*, Third Edition.

**WCB QuizPak** can be used to give your students on-line practice with the topics of elementary algebra. You can choose multiple-choice and true-false items from the *Quiz Item File*, edit items, or add your own items. Students' on-line test results are graded and scores then recorded in a *GradePak* file.

### For the student

The *Student's Solutions Manual* contains overviews of every chapter of the text, chapter self-tests with solutions, and solutions to all proficiency checks, every other odd-numbered section exercise, and odd-numbered chapter review exercise problems. It is available for student purchase.

On the **Videotapes**, the instructor introduces a concept, provides detailed explanations of example problems that illustrate the concept, including applications, and concludes with a summary. All of the topics presented in each section of *Intermediate Algebra with Applications*, Third Edition are carefully reinforced by the comprehensive Wesner and Nustad Video series. The tapes are available free to qualified adopters.

The **Audiotapes** have also been developed specifically to accompany *Intermediate Algebra with Applications*, Third Edition. They begin with a complete synopsis of the section, followed by clear discussions of examples with warning and hints where appropriate. Exercises are solved for each section of the text. Students are directed to turn off the tape and solve a specific problem and turn the tape on again for a complete explanation of the correct solution.

The concepts and skills developed in *Intermediate Algebra with Applications*, Third Edition are reinforced through the interactive **Intermediate Algebra Tutorial Practice Software**. Students practice solving section-referenced problems generated by the computer and review the major topics of elementary algebra. Step-by-step solutions with explanations guide students to mastery of the major concepts and skills of elementary algebra.

**WCB QuizPak**, a part of *TestPak 3.0*, provides students with true/false and matching questions from the *Quiz Item File* for each chapter in the text. Using this portion of the program will help your students prepare for examinations. Items in *QuizPak* are similar in level and coverage of concepts as the *TestPak* items. Also included with the **WCB QuizPak** is an on-line testing option that allows professors to prepare tests for students to take using the computer. The computer will automatically grade the test and update the gradebook file.

### Acknowledgments

We wish to express our sincere thanks for the many comments and suggestions given to us during the preparation of the first edition. In particular, we wish to thank Lynne Hensel, William Lakey, and Douglas Nance for their excellent effort in reviewing each stage of the first edition and supplying us with numerous valuable comments, suggestions, and constructive criticisms.

For their help in typing the manuscript we thank Amy Miyazaki and Debbie Miyazakia, and a special thank you goes to Lisa Miyazaki for her superb aid in preparing the manuscript and for working all of the problems.

Because of his invaluable help and advice in the area of marketing, our sincere thanks go to Harold Elliott.

The authors would like to acknowledge the contribution of Philip Mahler, who introduced to them the idea of using the tabular format to list all possible combinations of factoring in factoring trinomials. Mr. Mahler was also responsible for the idea of using the sign of the product "mn" as an operation in the second column of the table. The chief virtue of this method is that it is algorithmic. The authors have modified the method slightly by listing the greater factor first.



Pauline Chow and Jean Shuttles of Harrisburg Area Community College deserve special thanks for their careful preparation of the *Instructor's Solutions Manual*.

Throughout the development, writing, and production of this text, two people have been of such great value that we are truly indebted to them for their excellent work on our behalf. We wish to express our utmost thanks to Suresh Ailawadi and Eugenia M. Collins.

We would like to thank the following reviewers of the third edition of *Intermediate Algebra with Applications*:

Donald W. Bellairs  
*Grossmont College*

Tom Cochran  
*Belleville Area College*

Gregory J. Davis  
*University of Wisconsin-Green Bay*

Virginia E. Hanks  
*Western Kentucky University*

Martha C. Jordan  
*Okaloosa-Walton Community College*

Herbert F. Kramer  
*Longview Community College*

Vince McGarry  
*Austin Community College*

Marilyn Morrison  
*Volunteer State Community College*

Linda J. Padillo  
*Joliet Junior College*

Gus Pekara  
*Oklahoma City Community College*

Gerry C. Vidrine  
*Louisiana State University*

Deborah A. Vrooman  
*Coastal Carolina College of the University of South Carolina*

In addition, we would like to thank the reviewers of *Principles of Intermediate Algebra with Applications*, First and Second Editions and *Intermediate Algebra with Applications*, Second Edition, whose comments have positively influenced this edition.

Dr. Joseph Altinger  
*Youngstown State University*

Daniel Anderson  
*University of Iowa*

Dorothy Batta  
*Wilber Wright College*

Charles M. Beals  
*Hartnell College*

Philip Beckman  
*Black Hawk College*

Donald W. Bellairs  
*Grossmont College*

James Blackburn  
*Tulsa Junior College*

Nancy Bray  
*San Diego Mesa College*

Ann S. Bretscher  
*University of Georgia*

Dan Burns  
*Sierra College*

Helen Burrier  
*Kirkwood Community College*

Richard A. Butterworth  
*Massasoit Community College*

Vern Byer  
*University of Maine-Farmington*

William Chatfield  
*University of Wisconsin-Platteville*

Al H. Chew  
*Central Arizona College*

Deann Christianson  
*University of the Pacific*

Duane Deal  
*Ball State University*

Mark Dugopolski  
*Southeastern LA University*

Ray Fatch  
*Eastern Oklahoma State College*

Fred W. Fischer  
*North Seattle Community College*

Richard L. Francis  
*Southeast Missouri State University*

Kenneth O. Gamon  
*Central Washington University*

Margaret J. Greene  
*Florida Junior College*

Pamela Hager  
*College of the Sequoias*

Shelby Hawthorne  
*Thomas Nelson Community College*

Lynne Hensel  
*Henry Ford Community College*

Joyce Huntington  
*Walla Walla Community College*

James Johnson  
*Modesto Junior College*

Glen Just  
*Mount Saint Clare College*

Chris Kolaczewski  
*University of Akron*

William Lakey  
*Central Michigan University*

Carolyn Likins  
*Millikin University*

Karla Martin  
*Middle Tennessee State University*

Raymond A. Maruca  
*Delaware County Community College*

Alfred W. Milligan  
*Western New Mexico University*

Ronald Milne  
*Goshen College*

Jesse Moore  
*John A. Logan College*

Douglas W. Nance  
*Central Michigan University*

Ardash Ozsogomonyan  
*College of San Mateo*

Sue Phillips  
*University of Nevada, Las Vegas*

Thomas Radin  
*San Joaquin Delta College*

George C. Ragland  
*St. Louis Community College at Florissant Valley*

J. Doug Richey  
*Henderson County Junior College*

Beverly Ridenhour  
*Utah State University*

Kenneth Ross  
*Broward Community College*

Grayson Sallez  
*University of North Carolina-Greensboro*

William Schneider  
*Fairmont St. College*

Annalee Scorsone  
*Lexington Community College*

John Snyder  
*Sinclair Community College*

John N. Strange  
*Hinds Junior College*

John Taylor  
*Hillsborough Community College*

Christina Vertullo  
*Marist College*

Gerry Vidrine  
*Louisiana State University*

Daniel Wachter  
*College of the Desert*

George Wales  
*Ferris State College*

Robert Wenger  
*University of Wisconsin-Green Bay*

Richard Werner  
*Santa Rosa Junior College*

Peter Williams  
*University of Maine*

Judy Willoughby  
*Maples Community College*

Jerry Wisnieski  
*Des Moines Area Community College*

Dick Wong  
*College of Lake County*

Donald Zalewski  
*Northern Michigan University*

Ben F. Zirkle  
*Virginia Western Community College*

Richard Zucker  
*Saddleback College North Campus*

Finally, we are grateful to our "book team," for without them there would be no book. In particular, we would like to express our sincere thanks to Earl McPeck, Gene Collins, Theresa Grutz, K. Wayne Harms, and Carrie Burger.



# Love The Taste. Taste The Love.

At Culver's® we can't think of anything better than serving up our creamy frozen custard and delicious classics cooked fresh the minute you order them. Which is why when we bring them to your table, they're always accompanied by a warm smile and a friendly offer to see if there's anything else we can get for you. So come on into your neighborhood Culver's and see for yourself. You might just be in love by the time you leave.





# Study Tips

**W**hen you work to your full capacity, you can hope to attain the knowledge and skills that will enable you to create your future and control your destiny. If you do not, you will have your future thrust upon you by others.

*A Nation at Risk\**

There are certain study skills that you as an algebra student need to have, or develop, to assure your success in this course. In addition to the following items listed, acquaint yourself with the text by reading the preface material that precedes these study tips. Then—

1. For every hour spent in class, plan to spend at least two hours studying outside class.
2. Before going to class, read the material to be covered. This will help you more easily understand the instructor's presentation.
3. Take time to become familiar with the learning aids in your textbook. This will allow you to get the maximum benefit from them. In *Intermediate Algebra with Applications*, Third Edition color has been used to tie related features together.
  - **Green** is used for the core concepts, ideas, and exercises. Be sure you understand everything highlighted with green.
  - **Blue** indicates additional explanation and greater detail.
  - **Red** is used to identify quick checks and quick-reference examples, which give you greater opportunity to check your understanding of each problem type.
4. Review the material related to each exercise set *before* attempting to work the problems. Be sure you understand the underlying concepts in the worked-out examples and the reason for each step.
5. Carefully read the instructions to the exercise set. Look at the examples and determine what is being asked. Remember, these same instructions will most likely appear on tests.

6. When working the exercise set, take your time, think about what you are doing in each step, and ask yourself why you are performing that step. As you become more confident, increase your speed to better prepare yourself for test situations.
7. When working the exercise sets, compare examples to see in what ways they are alike and in what ways they are different. Problems often *look* similar but are not.

If you do not know how to begin a problem, or you get partway through and are unable to proceed, (a) look back through your notes or (b) look for an exercise you can do that has the answer given and try to analyze the similarities. If doing these things does not work, put the problem aside. Often getting away from it for a time will “open the door” when you try it again. Finally, if you need to, consult your instructor and show him/her the work you have done.

The fact that you will be “using tomorrow what you are doing today” makes it imperative that you learn each concept as you go along. Most concepts, especially the ones that give you the most difficulty, need constant review.

The practice of checking your work will aid you in two ways:

1. It will develop confidence, knowing you have done the problem correctly.
2. It will help you discover your errors on an exam that might otherwise have gone undetected had you not checked your work.

When checking your work, use a different method from the one you used to solve the problem. If the same procedure is used, a tendency to make the same mistake exists. Develop methods for checking your work as you do the practice exercises. This checking then becomes automatic when taking a test.

The following hints will aid you in preparing for an exam:

1. Begin studying and reviewing a number of days prior to the exam. This will enable you to contact your instructor for help if you need it. “All-night” sessions the night before the exam seldom (if ever) yield good results.

\*The National Commission on Excellence in Education. *A Nation at Risk*. Washington, D.C.: U.S. Government Printing Office, 1983.

2. Take periodic breaks—10 to 15 minutes for each hour of study. Study for no longer than four hours at a time.
3. Work to develop understanding as well as skills. Memorization is seldom useful in an algebra course, so concentrate on understanding the methods and concepts. However do not ignore skill development, since doing so can often lead to what students call “stupid mistakes.”

Prior to taking an exam, use the exercise sets, chapter reviews, and/or *Student's Solutions Manual* to make out a practice test, determine where your errors lie, and retake the test to be sure that you have corrected the mistakes. Allot the same amount of time you will be allowed on test day.

When taking the algebra exam you should:

1. Look over the exam to locate the easiest problems.
2. Work these problems first.
3. Work the more difficult and time-consuming problems next. Remember, when stuck on a problem, go on to other problems and return to those giving you difficulty *only after* completing all that you can.
4. Use what time remains to check your answers or to rework those problems that you found most difficult.

Don't panic should you “draw a blank.” Avoid thoughts of failure. Should you feel this happening, relax and try to clear your mind. Search out the problems you feel most confident about and begin again. Should you be unable to complete the exam, be sure to check the problems that you have completed. Always be aware of the time remaining. Do not hurry and do not be intimidated by other students completing the exam early.

One final bit of advice. Show your work neatly. Develop this habit when working on your practice problems. There is a close correlation between neatly laid-out work and the correct answer. Your instructor will appreciate this and be more inclined to give you more credit if the answer is wrong.